Ordering number : EN4298A

Monolithic Linear IC



No.4298A

LA1831, 1831M

Support for AM Stereo and Electronic Tuning Single Chip Music Center IC (AM/FM IF + MPX) for Use in Compact Radio/Casette Products

Overview

The LA1831 is a single chip AM/FM IF and MPX tuner IC that supports electronic tuning. This chip was developed for consumer audio systems and is optimal for auto-seek systems based on IF count methods used together with SD.

Since no adjustments are required in the FM detector and MPX VCO circuits, use of this chip can significantly reduce the number of adjustment steps in the end-product manufacturing line.

Functions

AM: RF amplifier, mixer, oscillator (with ALC), IF amplifier, detector AGC, oscillator buffer, tuning indicator, IF buffer output, stereo IF output.

FM IF: IF amplifier, quadrature detector, S curve detection, tuning indicator, IF buffer output, S-meter

MPX: PLL stereo decoder, stereo indicator, force to mono, VCO stop

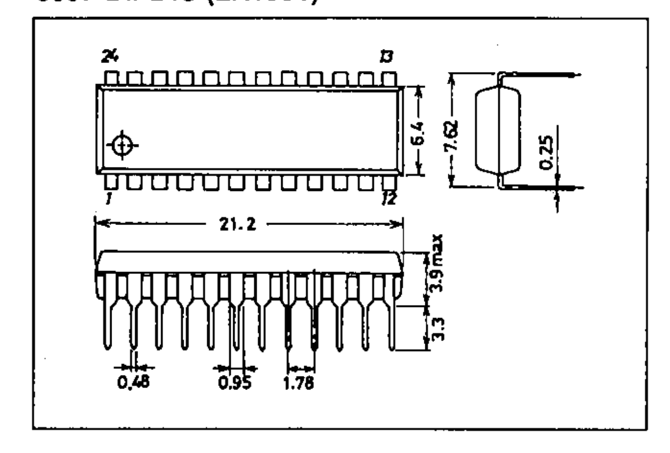
Features

- Major reduction in required adjustments
  - FM detector: No adjustments (ceramic discriminator used)
  - MPX VCO: No adjustments (ceramic resonator used)
- Tuning indicator pin provided (can be used as a narrow bandwidth stop signal or a muting drive output): SD output
- Supports IF count methods
- Variable FM stop sensitivity and bandwidth
- Built-in AM local oscillator buffer
- Supports AM low-cut control
- Pin compatible with the LA1830 (only the DIP version, the LA1831M is a new product)
- Built-in IF output function for AM stereo

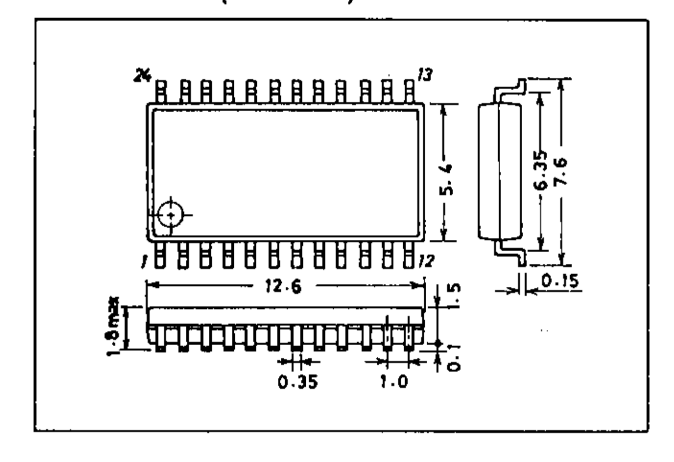
Package Dimensions

unit: mm

3067-DIP24S (LA1831)



3112-MFP24S (LA1831M)



Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Condition	Rating	Unit
Maximum supply voltage	V_{CC} max		9.0	V
Indicator drive current	I_{LED}	Pins 6 and 7	20	mA
Allowable power dissipation	Pd max	Ta ≤ 70°C (LA1831)	400	mW
		Ta = 70°C (LA1831M)	270	mW
Operating temperature	T_{opr}		–20 to +70	°C
Storage temperature	T_{stg}		–40 to +125	°C

Operating conditions at Ta = 25°C

Parameter	Symbol	Rating	Unit
Recommended supply voltage	V_{CC}	5.0	V
Operating supply voltage range	V_{CC} op	4.0 to 8.0	V

Operating Characteristics, at Ta = 25°C, V_{CC} = 5.0 V, (for the specified test circuits)

FM Characteristics (mono): fc = 10.7 MHz, fm = 1 kHz

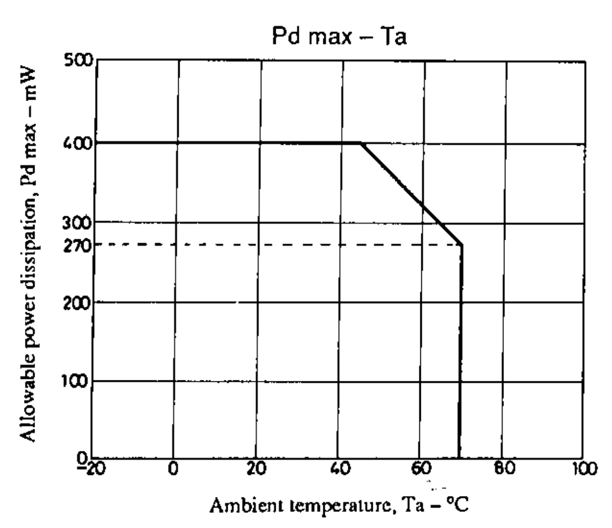
Parameter	Symbol	Condition	Ratings			Unit
			min	typ	max	
Quiescent current	I_{CCO}-FM	No input 19	12	23	33	mA
Demodulation output	V_O-FM	100 dBμ, 100% mod, pin 14 output	290	410	580	mVrms
Channel balance	C.B	100 dBμ, 100% mod, ratio of pin 14 to pin 15	–1.5	0	1.5	dB
Total harmonic distortion (mono)	THD-FMmono	100 dBμ, 100% mod, pin 14 output		0.3	1.5	%
Signal to noise ratio	S/N-FM	100 dBμ, 100% mod, pin 14 output	68	75		dB
Input limiting voltage	–3 dB L.S	With an input reference of 100 dBμ, the IF input that reduces the output by 3 dB		32	40	dBμ
LED sensitivity	$V_{LED\text{-}SENS}$	The IF input that turns the TU LED on	35	45	55	dBμ
LED bandwidth	LED-BAND	The frequency bandwidth that turns the TU LED on	70	110	160	kHz
IF count buffer output	$V_{IFBUFF\text{-}FM}$	The pin 10 output for 100 dBμ, no modulation	75	110	150	mVrms

FM Characteristics (stereo): fc = 10.7 MHz, fm = 1 kHz, L + R = 90%, PILOT = 10%, V_{IN} = 100 dBμ

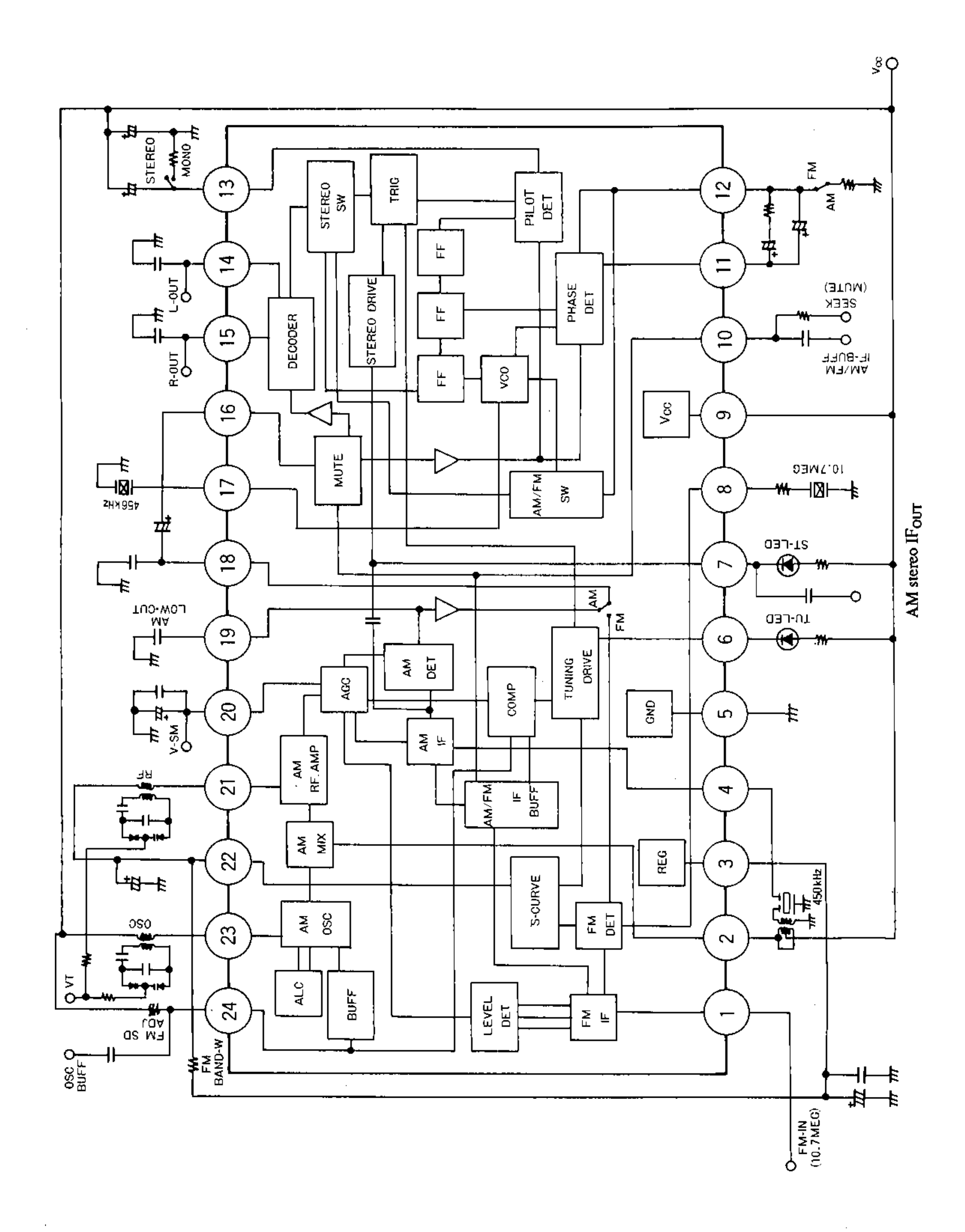
Parameter	Symbol	Condition	Ratings			Unit
			min	typ	max	
Separation	Sep	Pin 14 output	30	45		dB
Stereo on level	ST-ON	The pilot modulation level for which V_7 becomes less that 1.5 V	1.5	3.0	5.0	%
Total harmonic distortion (main)	THD-Main	Pin 14 output		0.3	1.5	%

AM Characteristics: fc = 1000 kHz, fm = 1 kHz, 30% modulation

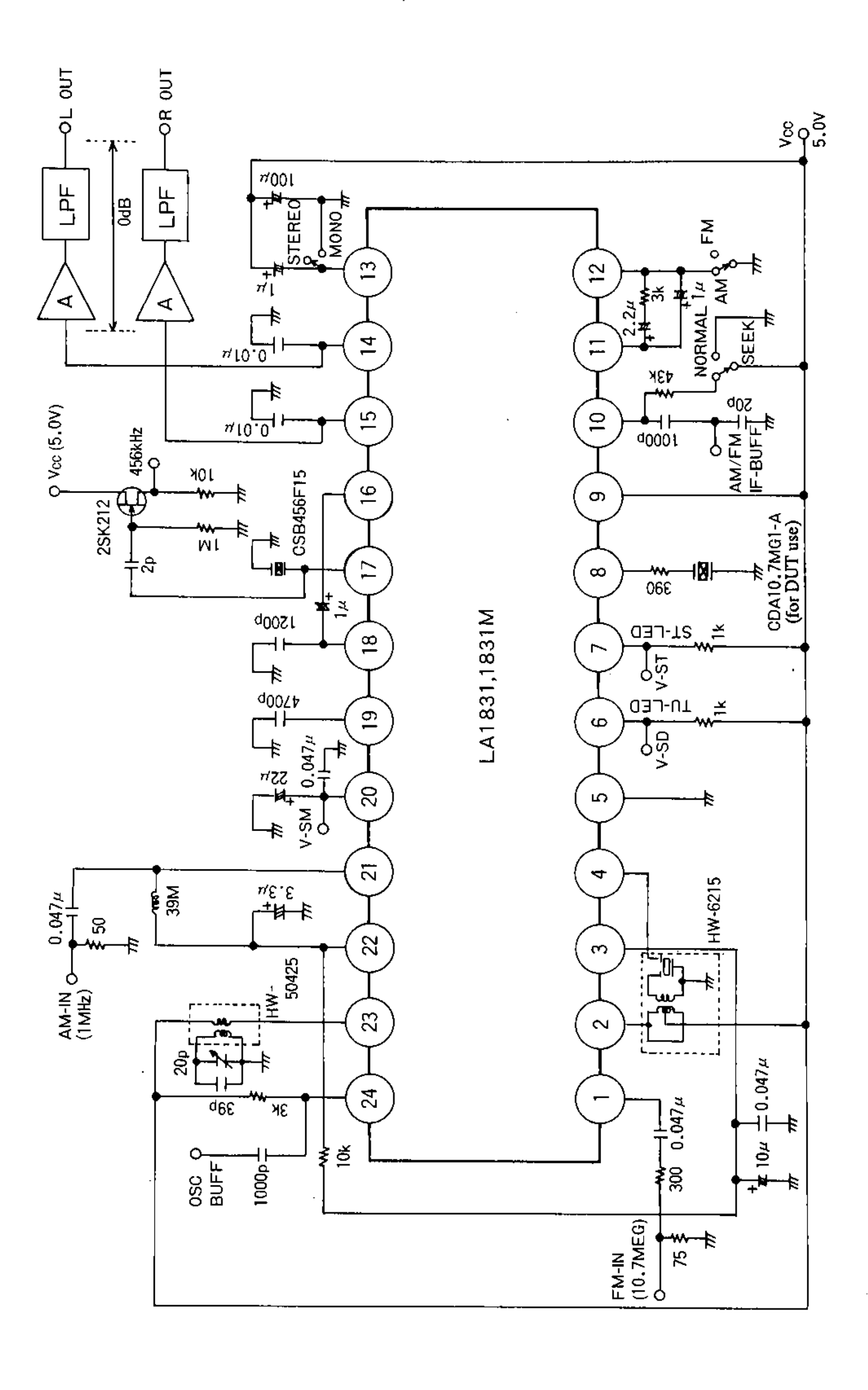
Parameter	Symbol	Condition	Ratings			Unit
			min	typ	max	
Quiescent current	I_{CCO}-AM	No input 19	10	20	33	mA
Detector output	V_O 1	23 dBμ, pin 14 output	25	50	100	mVrms
	V_O 2	80 dBμ, pin 14 output	80	130	200	mVrms
Signal to noise ratio	S/N 1	23 dBμ, pin 14 output	16	20		dB
	S/N 2	80 dBμ, pin 14 output	48	54		dB
Total harmonic distortion	THD-AM	80 dBμ, pin 14 output		0.3	1.0	%
		100 dBμ, pin 14 output		0.4	1.2	%
LED sensitivity	$V_{LED\text{-}SENS}$	The ANT input level at which the TU LED turns on	19	29	39	dBμ
Local oscillator buffer output	$V_{OSC\text{-}AM}$	No input, pin 24 output	140	200		mVrms
Low band attenuation	LOW-$_{CUT}$	Output when fm = 100 Hz, for a fm = 1 kHz reference	7	9	13	dB
IF count buffer output	$V_{IFBUFF\text{-}AM}$	80 dBμ, no modulation, pin 10 output	125	180	250	mVrms
Stereo IF output	V_{ST}-I_F-AM	80 dBμ, no modulation, pin 7 output	7.0	15.0		mVrms



Equivalent Circuit Diagram



Test Circuit Diagram



Unit (resistance: Ω, capacitance: F)

Pin Functions and No-Signal Voltages

No.	Function	Pin voltage (V)	Equivalent circuit	Notes
1	FM IF input	2.1		Input impedance ri = 330 Ω
2	AM MIX output	5.0		Used for the MIX coil between pin 2 and pin 9 (the V_{CC} voltage)
3	REG	2.1		V_{reg} = 2.1 V
4	AM IF input	2.1		Input impedance r_i = 2 kΩ
5	GND	0		
6	Tu-LED	5.0		Active-(L)
7	IF output for ST-LED and AM stereo			Open collector
8	FM-DET	2.8 (FM) 3.4 (AM)		Recommended ceramic discriminator: CDA10.7MG43 (Murata, Ltd)
9	V_{CC}	5.0		
10	AM/FM IF count output control SW, and mute SW	0		IF count and mute are turned on when V_{IO} > 3.0 V Note: During seek, the IF buffer is output only in the SD on state.
11	Phase comparator filter pin, and AM/FM switch	Pin 11 3.8 (FM) 1.5 (AM)		AM mode is selected when over 200 μA flows from pin 12
12		Pin 12 3.8 (FM) 0 (AM)		

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No.	Function	Pin voltage (V)	Equivalent circuit	Notes
13	Pilot detector filter pin, force to mono, VCO stop	3.5	13	Mode forced to mono when over 50 µA flows from this pin The VCO stops at currents over 200 µA
14 15	Left output Right output	1.2	14 (15)	Output impedance r_o = 5 kΩ
16	MPX input	2.1	16	Input impedance r_i = 20 kΩ
17	MPX VCO	2.4 (FM) 0 (AM)	17	Recommended ceramic oscillator: CSB456F15 (Murata, Ltd)
18	AM/FM demodulator output	2.1 (FM) 1.3 (AM)	18	Output impedance FM: r_o = 2.3 kΩ AM: r_o = 10 kΩ
19	AM LOW CUT	1.5 (FM) 2.0 (AM)	100k 19	The low band frequency characteristics are changed by an external capacitor connected at pin 19
20	S-meter, AM AGC	0.2 (FM) 0.6 (AM)	20 R	Built-in load resistance: R = 13.9 kΩ An external capacitor connected at pin 20 determines the seek time SD response speed
21	AM RF-IN	2.1	21	Pin 21 is used at the same potential as pin 22 (the AFC voltage)
22	AFC	2.1	22	The FM-SD bandwidth can be changed with an external resistor connected between pin 22 and pin 3 Note: A setting of 180 kHz or higher is recommended for the FM-SD bandwidth.

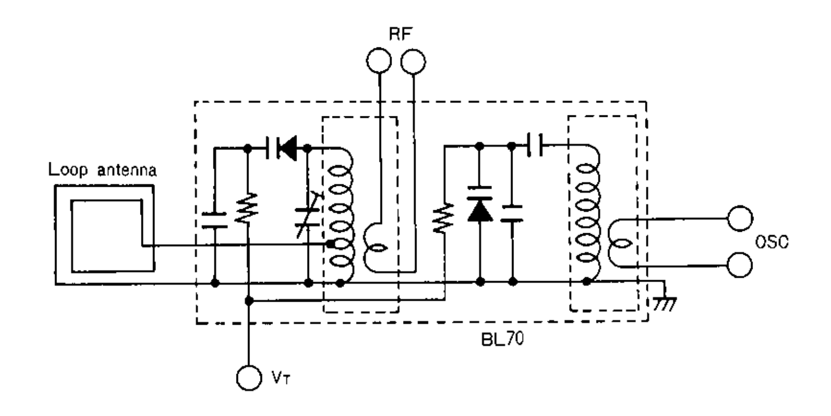
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No.	Function	Pin voltage (V)	Equivalent circuit	Notes
23	OSC	5.0	23	An oscillator coil is used between pin 23 and pin 9 (the V_{CC} voltage) Note: An oscillator coil with an impedance of 5 kΩ or over (secondary side) should be used.
24	OSC buffer, FM SD adj.	3.6	R 24 200 Ω	The FM SD sensitivity can be changed with an external resistor connected at pin 24 Note: A resistor of 3 kΩ or over should be used for the pin 24 external resistor.

Coil Specifications

AM ANT BLOCK

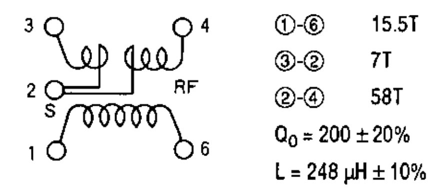


Loop antenna

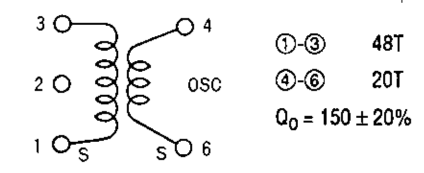
- LA300 (Kohringiken, Ltd.)

Loop antenna matching coil

- KL-412 (Kohringiken, Ltd.) (for use with the SVC321)

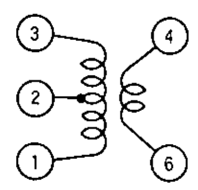


- KO-387 (Kohringiken, Ltd.) (for SVC321 use)



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- AM OSC (for DUT use)
  HW-50425 (Mitsumi, Ltd.)



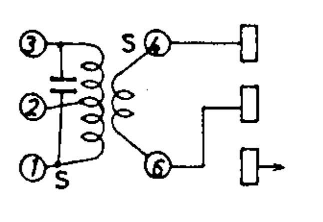
③-② 2T
④-⑥ 9T
②-① 86T
$Q_0 \geq 80$
L = 270 μH

- IFT
  YD-1073-1 (Mitsumi, Ltd.)

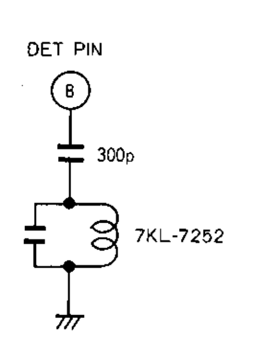
S
③
④
②
①
S
⑥
SFU450B
YD-1073

①-② 58T
④-⑥ 7T
②-③ 94T
f_0 = 450 kHz
Q_0 = 110
180 pF internal
SFU 450B

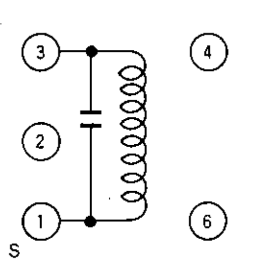
- IFT (for DUT use)
  HW-6215 (Mitsumi, Ltd.)



HW-6194
SFU-450B
①-② 94T
④-⑥ 7T
②-③ 58T
180 p



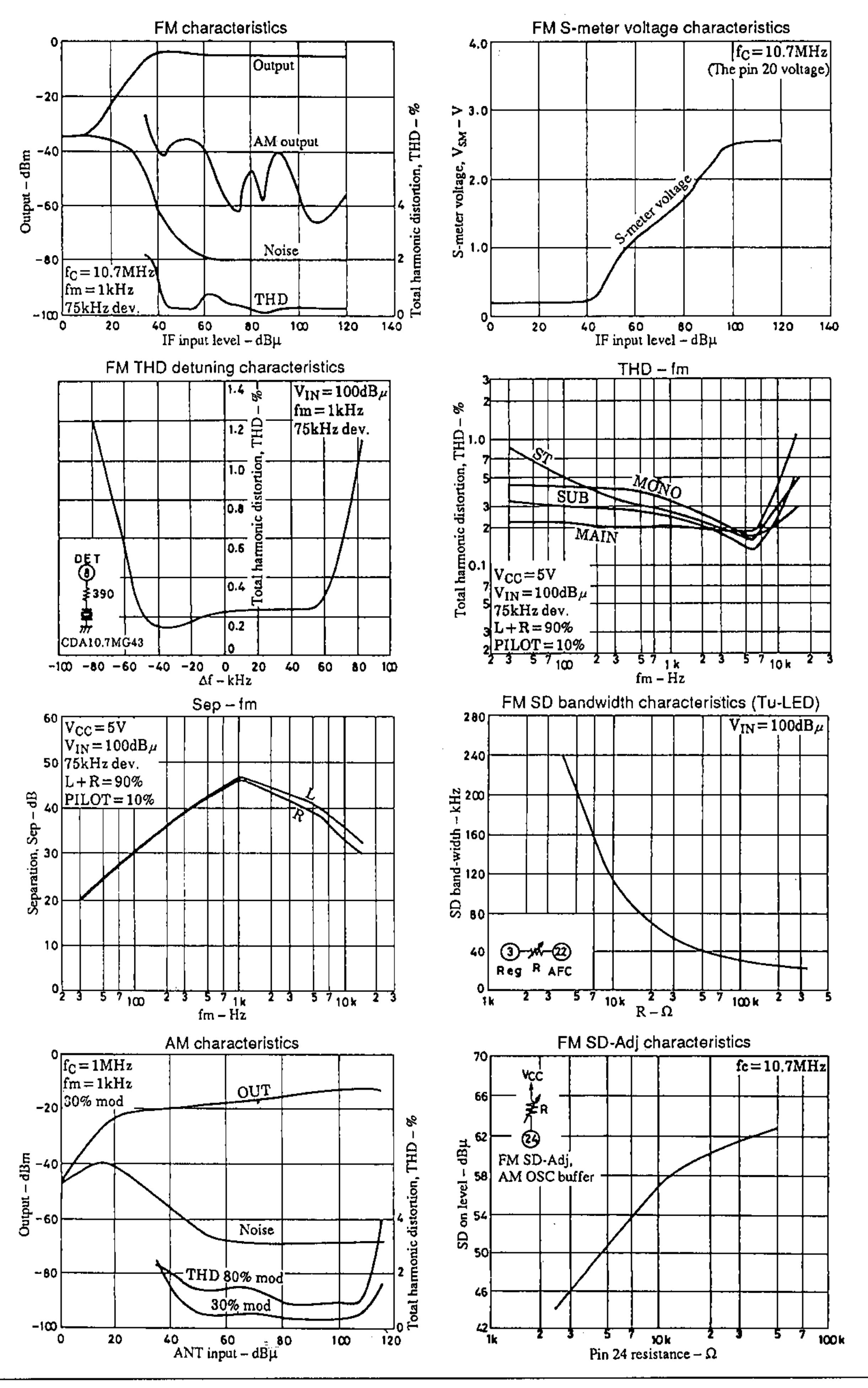
- FM DET
  7KL-7252 (Toko, Ltd.)

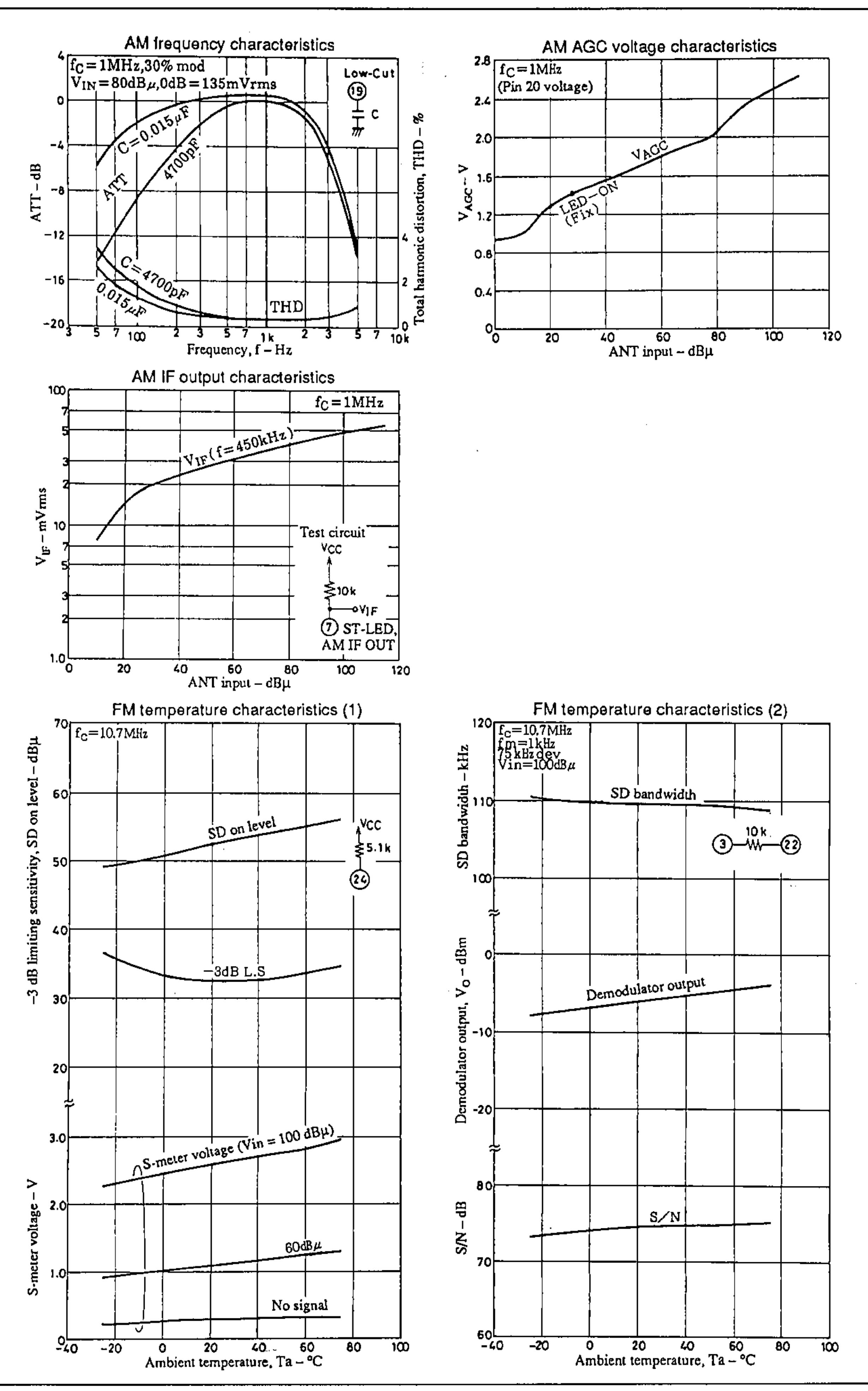


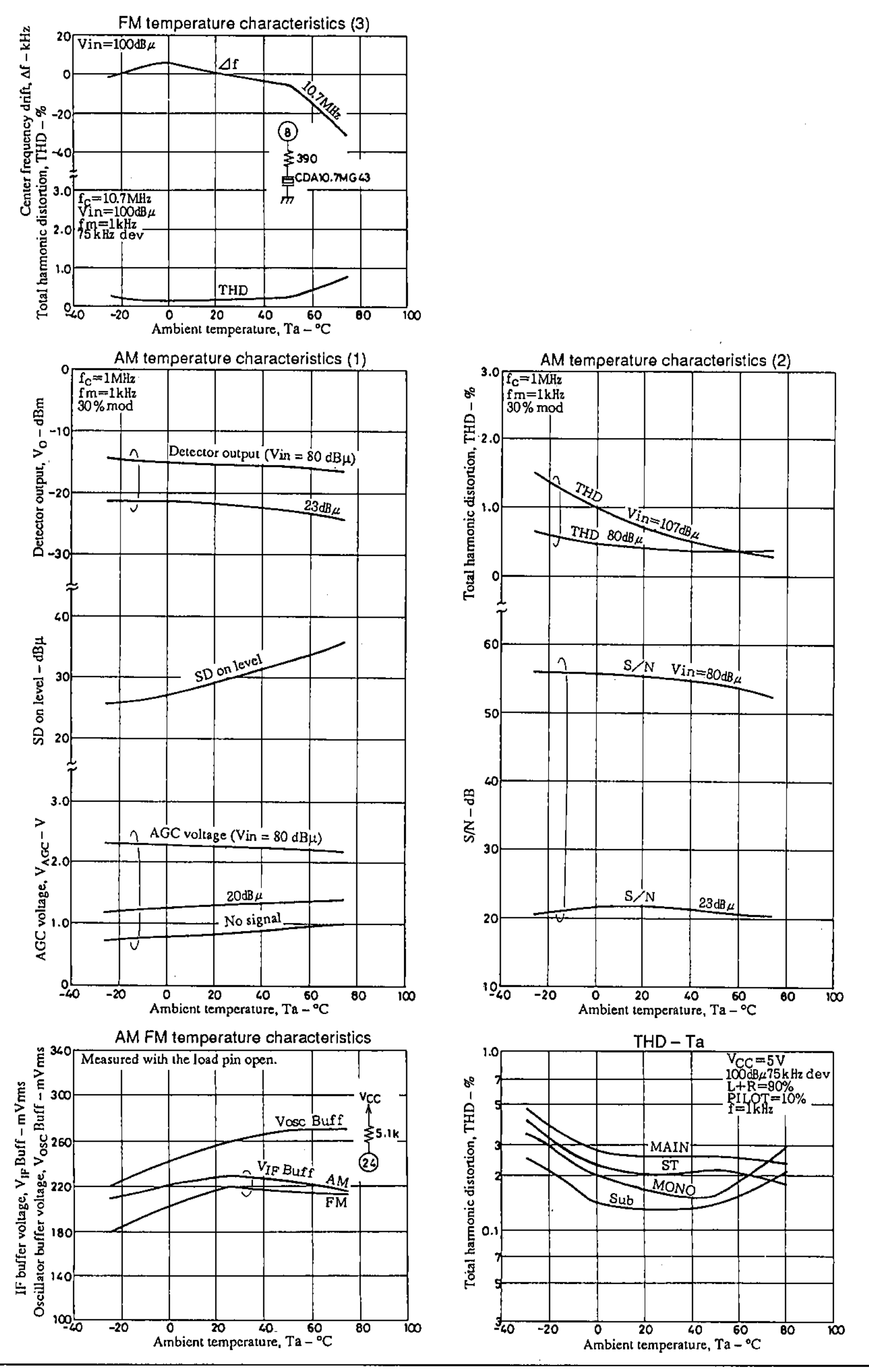
①-③ 15T
f_0 = 10.7 MHz
Q_0 = 85 ± 20%
12 pF internal

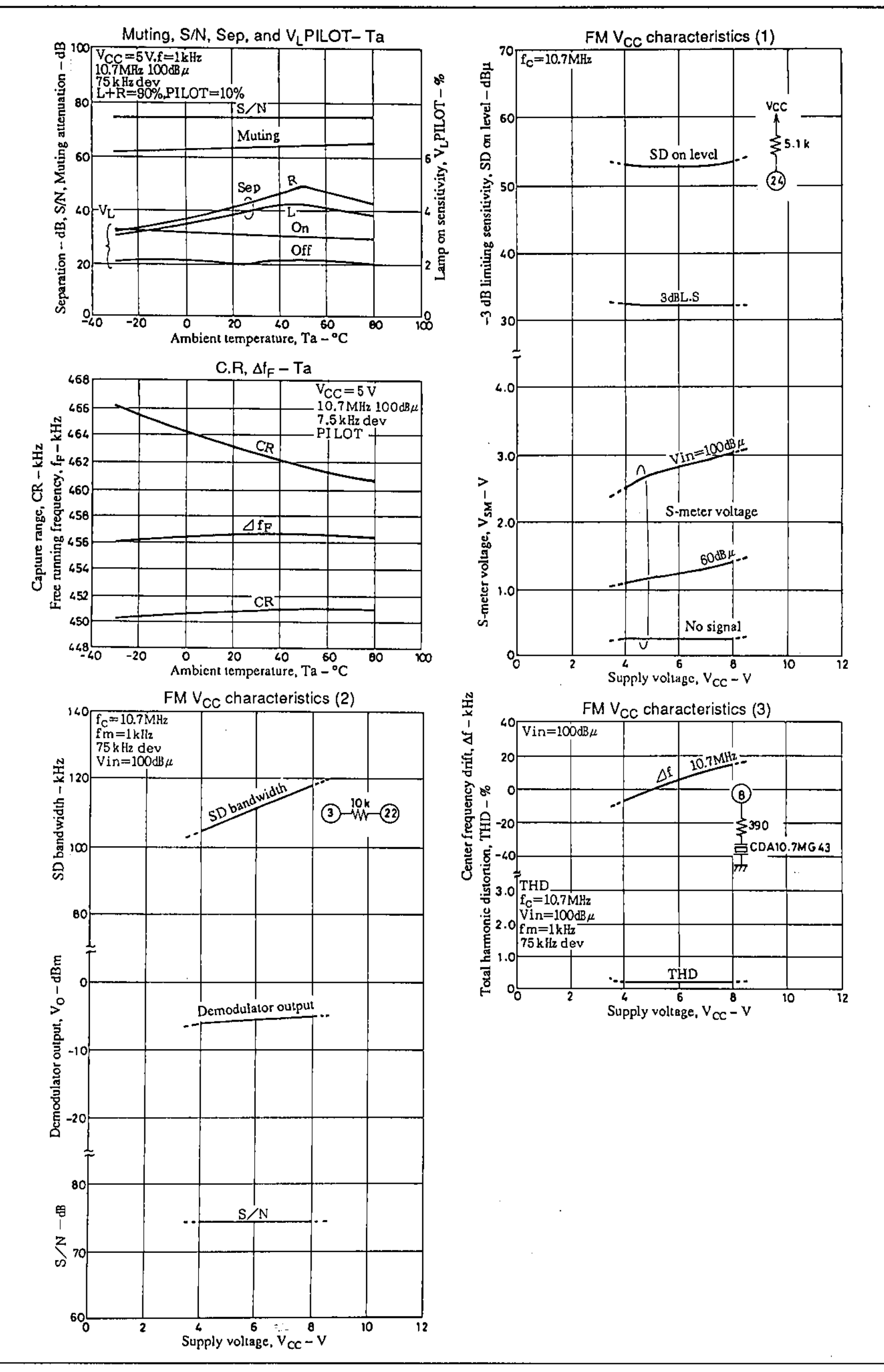
Unit (capacitance: F)

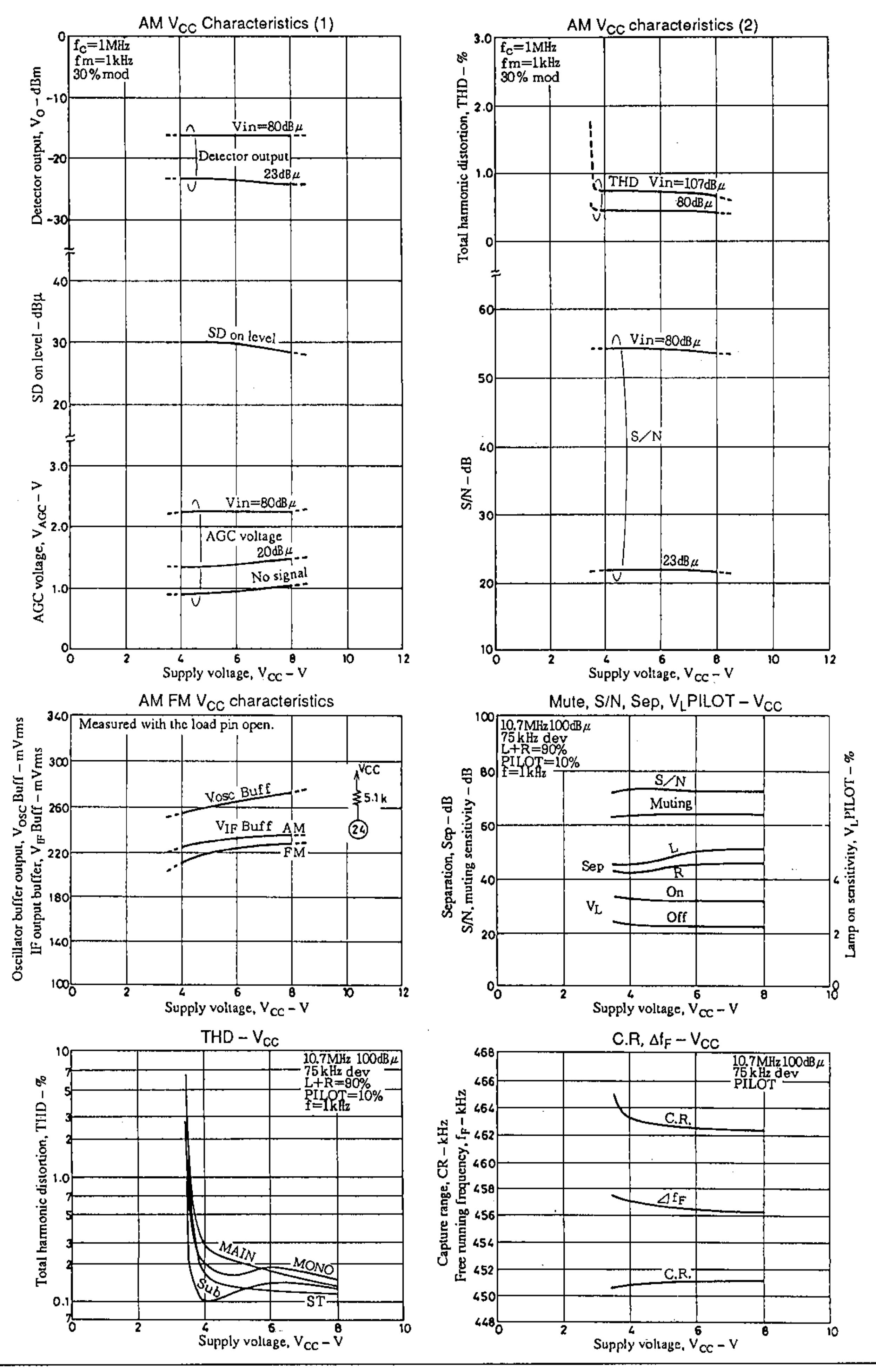
- Application circuit using an FM detector coil


FM characteristics
Output
AM output
Noise
THD
fC=10.7MHz
fm=1kHz
75kHz dev.
Output - dBm
Total harmonic distortion, THD - %
IF input level - dBμ
FM S-meter voltage characteristics
fC=10.7MHz
(The pin 20 voltage)
S-meter voltage
S-meter voltage, VSM - V
IF input level - dBμ
FM THD detuning characteristics
VIN=100dBμ
fm=1kHz
75kHz dev.
DET
390
CDA10.7MG43
Total harmonic distortion, THD - %
Δf - kHz
THD - fm
ST
MONO
SUB
MAIN
VCC=5V
VIN=100dBμ
75kHz dev.
L+R=90%
PILOT=10%
Total harmonic distortion, THD - %
fm - Hz
Sep - fm
VCC=5V
VIN=100dBμ
75kHz dev.
L+R=90%
PILOT=10%
L
R
Separation, Sep - dB
fm - Hz
FM SD bandwidth characteristics (Tu-LED)
VIN=100dBμ
Reg R AFC
SD band-width - kHz
R - Ω
AM characteristics
fC=1MHz
fm=1kHz
30% mod
OUT
Noise
THD 80% mod
30% mod
Output - dBm
Total harmonic distortion, THD - %
ANT input - dBμ
FM SD-Adj characteristics
fc=10.7MHz
VCC
R
FM SD-Adj,
AM OSC buffer
SD on level - dBμ
Pin 24 resistance - Ω


AM frequency characteristics
fC=1MHz,30% mod
VIN=80dBμ,0dB=135mVrms
Low-Cut
19
C
C=0.015μF
4700pF
ATT
C=4700pF
0.015μF
THD
ATT – dB
Total harmonic distortion, THD – %
Frequency, f – Hz
AM AGC voltage characteristics
fC=1MHz
(Pin 20 voltage)
VAGC
LED–ON
(Fix)
VAGC – V
ANT input – dBμ
AM IF output characteristics
fC=1MHz
VIF(f=450kHz)
Test circuit
VCC
10k
VIF
7 ST-LED,
AM IF OUT
VIF – mVrms
ANT input – dBμ
FM temperature characteristics (1)
fC=10.7MHz
SD on level
VCC
5.1k
24
–3dB L.S
S-meter voltage (Vin = 100 dBμ)
60dBμ
No signal
–3 dB limiting sensitivity, SD on level – dBμ
S-meter voltage – V
Ambient temperature, Ta – °C
FM temperature characteristics (2)
fC=10.7MHz
fm=1kHz
75kHz dev
Vin=100dBμ
SD bandwidth
3
10k
22
Demodulator output
S/N
SD bandwidth – kHz
Demodulator output, VO – dBm
S/N – dB
Ambient temperature, Ta – °C


FM temperature characteristics (3)
Vin=100dBμ
Δf
10.7MHz
390
CDA10.7MG43
f_c=10.7MHz
Vin=100dBμ
fm=1kHz
75kHz dev
THD
Center frequency drift, Δf – kHz
Total harmonic distortion, THD – %
Ambient temperature, Ta – °C
AM temperature characteristics (1)
f_c=1MHz
fm=1kHz
30%mod
Detector output (Vin = 80 dBμ)
23dBμ
SD on level
AGC voltage (Vin = 80 dBμ)
20dBμ
No signal
Detector output, V_O – dBm
SD on level – dBμ
AGC voltage, V_{AGC} – V
Ambient temperature, Ta – °C
AM temperature characteristics (2)
f_c=1MHz
fm=1kHz
30%mod
THD
Vin=107dBμ
THD 80dBμ
S/N Vin=80dBμ
S/N 23dBμ
Total harmonic distortion, THD – %
S/N – dB
Ambient temperature, Ta – °C
AM FM temperature characteristics
Measured with the load pin open.
Vosc Buff
V_{IF} Buff
AM
FM
V_{CC}
5.1k
IF buffer voltage, V_{IF} Buff – mVrms
Oscillator buffer voltage, V_{osc} Buff – mVrms
Ambient temperature, Ta – °C
THD – Ta
V_{CC}=5V
100dBμ75kHz dev
L+R=90%
PILOT=10%
f=1kHz
MAIN
ST
MONO
Sub
Total harmonic distortion, THD – %
Ambient temperature, Ta – °C


Muting, S/N, Sep, and V_L PILOT– Ta
VCC=5V,f=1kHz
10.7MHz 100dBμ
75kHz dev
L+R=90%,PILOT=10%
S/N
Muting
Sep
R
L
On
Off
Separation – dB, S/N, Muting attenuation – dB
Lamp on sensitivity, V_L PILOT – %
Ambient temperature, Ta – °C
C.R, Δf_F – Ta
VCC=5V
10.7MHz 100dBμ
7.5kHz dev
PILOT
CR
Δf_F
Capture range, CR – kHz
Free running frequency, f_F – kHz
FM VCC characteristics (1)
fc=10.7MHz
VCC
5.1k
SD on level
3dBL.S
Vin=100dBμ
S-meter voltage
60dBμ
No signal
–3 dB limiting sensitivity, SD on level – dBμ
S-meter voltage, V_SM – V
Supply voltage, VCC – V
FM VCC characteristics (2)
fc=10.7MHz
fm=1kHz
75kHz dev
Vin=100dBμ
SD bandwidth
10k
Demodulator output
S/N
SD bandwidth – kHz
Demodulator output, V_O – dBm
S/N – dB
FM VCC characteristics (3)
Vin=100dBμ
Δf
10.7MHz
390
CDA10.7MG43
THD
fc=10.7MHz
Vin=100dBμ
fm=1kHz
75kHz dev
Center frequency drift, Δf – kHz
Total harmonic distortion, THD – %


AM V_{CC} Characteristics (1)
fc=1MHz
fm=1kHz
30% mod
Detector output, V_O – dBm
Vin=80dBμ
Detector output
23dBμ
SD on level – dBμ
SD on level
AGC voltage, V_{AGC} – V
Vin=80dBμ
AGC voltage
20dBμ
No signal
Supply voltage, V_{CC} – V
AM V_{CC} characteristics (2)
fc=1MHz
fm=1kHz
30% mod
Total harmonic distortion, THD – %
THD Vin=107dBμ
80dBμ
S/N – dB
Vin=80dBμ
S/N
23dBμ
Supply voltage, V_{CC} – V
AM FM V_{CC} characteristics
Measured with the load pin open.
Oscillator buffer output, V_{OSC} Buff – mVrms
IF output buffer, V_{IF} Buff – mVrms
Vosc Buff
V_{IF} Buff AM
FM
VCC
5.1k
24
Supply voltage, V_{CC} – V
Mute, S/N, Sep, V_LPILOT – V_{CC}
10.7MHz100dBμ
75kHz dev
L+R=90%
PILOT=10%
f=1kHz
Separation, Sep – dB
S/N, muting sensitivity – dB
Lamp on sensitivity, V_LPILOT – %
S/N
Muting
Sep
L
R
V_L
On
Off
Supply voltage, V_{CC} – V
THD – V_{CC}
10.7MHz 100dBμ
75kHz dev
L+R=90%
PILOT=10%
f=1kHz
Total harmonic distortion, THD – %
MAIN
MONO
Sub
ST
Supply voltage, V_{CC} – V
C.R, Δf_F – V_{CC}
10.7MHz100dBμ
75kHz dev
PILOT
Capture range, CR – kHz
Free running frequency, f_F – kHz
C.R.
Δf_F
C.R.
Supply voltage, V_{CC} – V